MA114 Worksheet for Section 8.4

Skills

1. Find the work done pushing a car a distance of 8 meters while exerting a constant force of 900 Newtons.
2. How much work is done by a weightlifter in raising a 200 kg barbell from the floor to a height of 2 m?
3. A particle is moved along the x-axis by a force that measures $5x^2 + 1$ pounds at a point x feet from the origin. Find the work done in moving the particle from the origin to a distance of 10 ft.
4. A spring, whose unstretched length is 1 meter, stretches to a length of 3 meters when a force of 3 Newtons is applied.
   (a) Find the work needed to stretch the spring to a length of 2 meters from its natural length.
   (b) How much work is required to compress the spring to a length of .5 meters?
5. If the work required to stretch a spring 1 ft beyond its natural length is 12 ft. -lbs.
   (a) How much work is needed to stretch it to 9 in. beyond its natural length?
   (b) How far beyond its natural length will a force of 30 Newtons keep the spring stretched?
6. An aquarium 2m long, 1m wide and 1m deep is full of water. Find the work needed to pump half the water out of the aquarium.

Concepts

1. A cable that weighs 2 lbs/ft. is used to lift 800 lbs of coal up a mineshaft 500 ft. deep. Find the work done.
2. A full water tank in the shape of an inverted right circular cone is 8 meters across the top and 4 meters high.
   (a) How much work is required to pump all the water over the top of the tank?
   (b) If the surface of the water in the tank is 2 meters below the top of the tank, how much work is required to pump all the water over the top of the tank?
3. By *Coulomb's Law*, a positive charge m of electricity repels a unit of positive charge at a distance x with the force m/x^2. What is the work done when the unit charge is carried from $x = 2a$ to $x = a$?
4. A cable of uniform linear mass $\rho = 9$ kilograms per meter is being unwound from a cylindrical drum. If 15 meters are already unwound, what is the work done by gravity in unwinding 60 meters more?
5. Newton's *Law of Gravitation* states that two bodies with masses m_1 and m_2 attract each other with force
$$F = G\frac{m_1 m_2}{r^2}$$
where r is the distance between the two bodies and G is the gravitational constant. If one of the bodies is fixed, find the work needed to move the other from $r = a$ to $r = b$.
6. Use Newton's Law of Gravitation to compute the work required to launch a 1000-kg satellite vertically to an orbit 1000 km high. You may assume that the mass of the earth is 5.98×10^{24} kg and is concentrated at the center of the earth. Take the radius of the earth to be 6.37×10^6 m and $G = 6.67 \times 10^{-11}$ Nm^2/kg^2.
7. A container is formed by revolving the area under the graph of $y = x^2, 0 \leq x \leq 2$, about the y-axis. How much work is required to fill the container with water from a source 2 units below the x-axis by pumping through a hole in the bottom of the container?